DOCUMENT RESUME

ED 353 316 TM 019 380

AUTHOR Sutarso, Toto
TITLE Students' Attitudes toward Statistics (STATS).
PUB DATE Nov 92
NOTE 19p.; Paper presented at the Annual Meeting of the Mid-South Educational Research Association (Knoxville, TN, November 11-13, 1992). For a related document, see TM 019 400.
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150) -- Tests/Evaluation Instruments (160)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Attitude Measures; *College Students; Educational Attitudes; Factor Structure; Higher Education; Psychometrics; *Rating Scales; *Statistics; *Student Attitudes; *Test Construction; Test Reliability
IDENTIFIERS *Students Attitudes Toward Statistics Inventory; University of Alabama

ABSTRACT

The purposes of this study were to develop an instrument to measure students' attitude toward statistics (STATS), and to define the underlying dimensions that comprise the STATS. The instrument consists of 24 items. The sample included 79 male and 97 female students from the statistics classes at the College of Education and the College of Commerce and Business Administration at the University of Alabama (Tuscaloosa). Students were asked to indicate the extent to which each statement described them using a scale from 0 to 9. The resulting data show that the alpha reliability coefficient for the whole 24 items was 0.82. Then, after dropping the 3 weakest items, the reliability coefficient increased to 0.86. A principal components factor analysis with a varimax (orthogonal) rotation revealed the following six factors: (1) students' interest and future applicability; (2) relationship and impact of the instructor; (3) attitude toward statistical tools; (4) self-confidence; (5) parental influence; and (6) initiative and extra effort in learning statistics. The Students' Attitudes Toward Statistics inventory psychometric analysis revealed sound properties and therefore can be used by researchers and practitioners to measure students' attitudes about statistics. The instrument is included. (Author/RLC)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED353316

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Toto Sutarso

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

STUDENTS' ATTITUDES TOWARD STATISTICS

(STATS)

Toto Sutarso
The University of Alabama

Paper presented at the annual meeting of
the Mid-South Educational Research Association
Knoxville, Tennessee, November 1992

TM019380

BEST COPY AVAILABLE

Discussion

"STUDENTS' ATTITUDES TOWARD STATISTICS"

Toto Sutarso, University of Alabama

The purpose of the study was to develop an instrument to measure students' attitude toward statistics (STATS), and to define the underlying dimensions that comprise the STATS.

The instrument consisted of 24 items. Students were asked to what degree the statement described them using a scale from 0 to 9. The sample consisted of 79 male and 97 female students from the statistics classes in the College of Education and the College of Commerce & Business Administration at the University of Alabama.

The resulting data showed that the alpha reliability coefficient for the whole 24 items was .82. Then, after dropping the three weakest items, the reliability coefficient increased to .86. A principle component factor analysis with a varimax (orthogonal) rotation revealed six factors: students' interest and future applicability, relationship and impact of the instructor, statistical tools, self confidence, parental influence, and initiative and extra effort.

The Students' Attitudes Toward Statistics inventory psychometric analysis revealed sound properties and therefore can be used by researchers and practitioners to measure students' attitude toward statistics.

STUDENTS' ATTITUDES TOWARD STATISTICS (STATS)

Introduction

Today, statistics is considered one of the scientific tools, not only for describing data but also as an inductive method in research methodology. This distinguishes it as a very important subject, especially in higher education. Statistics is offered at every college. It is common, in some colleges, for statistics to be given in series of courses, from the very basic up to the advanced level.

In the contrary, statistics is considered a complicated field. Statistics is related to mathematics, probability, calculators, and computers. Many students avoid statistics since they feel that mathematics is a 'trouble maker' in their school. Also, probability is plagued from its reputation as an 'abstract' science. Furthermore, computers are thought of as the tool for the intelligent person only. From these conditions, statistics is presumed to be a very difficult discipline to learn.

Considering the two aspects above, investigating

students' attitudes toward statistics (STATS) is very important. Measuring their attitudes toward this field is needed. Is it true that their attitudes toward statistics so bad? What is the percentage of students who have a negative attitude? What are the issues that contribute to their attitudes? What variables relate to their attitude? What kind of instrument can be used to measure STATS? And what are the underlining factors or dimensions that comprise STATS are some of the very interesting questions.

The main purpose of this study is to develop an instrument to measure the STATS and to define the underlying dimensions that comprise the STATS.

Literature Review

Previous studies showed that there was a statistics anxiety among college students (Roberts & Bilderback. 1980; Roberts & Saxe. 1982; Frank & Rickard. 1988; Katz & Tomazik. 1988; and Benson. 1989). Moreover, Dillon (1982) reported that there is a statisticophobia in college level statistics classes.

Statistics anxiety, even less than statisticophobia, is 'dangerous' not only for the student but also for statistics itself, and for other sciences in general.

Students who are anxious about a class will feel the course is more difficult than it should be. The instructional goals will be difficult to achieve. For statistics itself, this situation will lead to an attitude of not liking statistics. Many students may try to avoid this class. On the contrary, statistics courses are needed as a research tool. Consequently, since statistics is a scientific tool in the research method, the bad attitudes toward statistics may lead to a bad impact for sciences in general, especially the sciences that are close related to it such as psychometry, sociometry, biometry, and econometrics.

Research tends to show that there is a positive relationship between STATS and student achievement. Research done by Robert and Saxe (1982), by using the Student Attitude Survey (SAS), indicated that the more positive the STATS the higher the statistics achievement. This finding was supported by Roberts and Reese (1987) who found that regardless of gender grouping, more positive STATS tended to show a higher course grade. Moreover, even though the instruments used were different, the data analysis still revealed the same finding. This statement was verified by Water, Martelli,

Zakrajsek & Popovich (1988) when they used both SAS and the Attitudes Toward Statistics (ATS) instrument of Wise (1985).

Benson (1989) used the Statistical Test Anxiety (STA) which he developed to measure a student anxiety in learning statistics. In the issue of the relationship between the STA score and the course grade, he came up with the conclusion that the higher the STA score the lower the course grade. In other words the more anxious the student was in learning statistics the lower the course grade. In addition, the consistent finding was also mentioned by Ware and Chastain (1989), the more positive the STATS, the lower their anxiety, and the higher the score achieved. In conclusion, the research showed that there was a positive relationship between STATS and course grade; and that, there was a negative relationship between anxiety and both STATS and course grade.

Some variables were found related to the STATS. However, others variables were found insignificant or there was inconsistent findings among the previous studies.

Research showed that there was a relationship

between STATS and statistics preknowledge. The correlation analysis tended to indicate that between the two variables there was a significantly positive correlation (Roberts & Saxe, 1982; Roberts & Reese, 1987; and Collis, Oberg, & Shera, 1989). Their research findings consistently showed the positive relationship between STATS and statistics preknowledge, or negative relationship between students' anxiety and statistics preknowledge.

However, regarding the relationship between STATS and a number of previous college mathematics completed, there was an inconsistency among research finding. Some researchers found that there was a positive relationship between the number of previous college mathematics courses completed and the STATS. The more previous college mathematics courses completed the more positive the STATS (Robert & Saxe, 1982; Roberts & Reese, 1987). However, the research done by Benson (1989) showed that even though there was a tendency that the more previous college mathematics completed the less anxious the student was in learning statistics but the correlation was not significant. His findings were supported by other researchers who mentioned that there was not enough

evidence to say that there was a relationship between number of college mathematics completed and STATS (Collis, Oberg, & Shera, 1989; Ware & Chastain, 1989).

Sex differences also revealed an inconsistency among the research findings. Roberts and Saxe (1982) concluded that there was a significant association between students' sex and their attitude toward statistics. Male students tended to have more positive attitude then their females counterpart. Consequently, the male students tended to have a better statistics achievement then their female counterparts. This finding was supported by other researchers. It was found that female students were more anxious than male students (Benson, 1989; and Zeidner & Safir, 1989). Then, male students tended to have higher scores in statistics then their female counterparts (Frank & Rickard, 1988; Waters, Martelli, Zakrajsek, & Popovich, 1988; Benson, 1989; and Ware & Chastain, 1989). However, Elmore & Vasu (1986) found the contrary. They showed that feminist issues were the significant predictor of statistics achievement. Female students showed better attitudes than male students did. Consequently, female students tended to have higher achievement compared with their male counterparts. This

finding was supported by Raiszadeh & Ahmadi (1987). Their data analysis showed that female students had higher statistical achievement than male students had.

Other variables which related to the STATS were also found by some researchers. They were material and instructor qualification (Johnson, 1980; Robert & Saxe, 1982; and Reisner, 1985), teaching methods (Reisner, 1985; Katz & Tomazik, 1988), computer (Ware & Chastain, 1989; and Collis, Oberg, & Shera, 1989), the status of a course required or elective, and calculator attitudes (Roberts & Saxe, 1982). However, research showed that ethnicity was not an indicator of significant difference of anxiety (Zeidner & Safir, 1989).

Method of the Study

The instrument was developed in four steps. The first step was defining the purpose of the study. The main purpose of the study was stated as in the part of Introduction previously. The second step was finding the issues associated with the purpose. Here, it was found the issues such as self confidence in learning statistics, expectation of success, effort, motivation, wariness (anxiety), future need, instructor qualification, attitudes toward mathematics, calculator,

computer, and some demographic characteristics. Some variables were found in the literature review and the others were defined based on empirical bases. The next step was deciding the items to elaborate the issues. In this step, items were developed after discussing with an expert in the field of measurement. Finally, the last step was constructing the instrument based on the items made.

The instrument was a set of statements (24 items) which allowed students to reflect themselves as **not describe me** or **describe me** with the range from 0 to 9. It was piloted to 20 students who took a statistics class. The purpose of this pilot study, especially, was to try out the instrument made. Based on the pilot study, the instrument was revised. Finally, it was administered to the statistics classes at the College of Education, and the College of Commerce & Business Administration, the University of Alabama. The classes consisted of undergraduate statistics classes (BER 340, ST 250, and ST 251), and the graduate statistics classes were (BER 540, BER 546, and ST 553). This sample consisted of 79 males and 97 females students.

Result and Discussion

The first and the second analyses were to examine the instrument appropriateness with reliability and validity analysis.

In general, for the whole 24 items, the reliability coefficient alpha was .82. The alpha if one item deleted ranged between .80 and .84. The weakest item out of 24 items, in term of reliability, was item 19, "If a statistics course were not required for my major I would not take one". This item was followed by item 23, "I did not like statistics before I took this class", and Item 9, "I feel that statistics is only for men". The part to whole Pearson Product Moment Correlation coefficient also showed that the three items had the lowest coefficient among all the items. None of them had significant correlation with the whole measurement.

Based upon the analysis above, the three items were dropped. After dropping the three items, the reliability coefficient alpha increase from .82 into .86. Moreover, there is no serious problem in consistency among the items.

The second analysis was discussing the validity of the instrument. The content validity was established in

two ways. First, the construct and its components were identified through a search of literature and empirically bases. Items were then developed and assessed by the author, and reviewed by an expert in the field of test development. The Criterion related validity was done by correlating the total score of the twenty four items with the student's score in midterm statistics course. The correlation showed highly significant ($p<.01$) with the coefficient .40

The third analysis was to determine the underlying dimensions that comprise the STATS. The R factor analysis was used for this purpose.

The scree plot indicated some choices about the number of factors to be retained. Someone could argue in choosing the number of factors, if just based upon the scree plot. The number of 9, 7, 6, and 4 might be chosen for the factors. However, since the number of item analyzed after dropping the three items was 21, choosing 9 or 7 factors was 'too risky', because some factors might have just one item loading to it. In addition, the eigen values of the factor analysis could complete the criteria for the decision. Based upon the minimum eigen values of one, choosing six factors was the most

interpretable one. Hence, in this study, six factors were retained.

Using orthogonal with Varimax rotation, each item loaded nicely to the factor. The dimensions of the six factors seemed to be: students interest and future applicability (items 10, 11, 12, 13, 14, and 18); relationship and impact of the instructor (items 20, 21, 22, and 24), statistical tools (items 4, 5, and 6); self confidence (items 1, 2, 3); parental influence (items 7, and 8; and the last one was initiative and extra effort (items 15, 16, and 17).

The total variance accounted for by the six factors was .72. This number was determined by summing the values for the six factors and dividing by the number of items (21). Factor 1 accounted for 6.2178, Factor 2 accounted for 2.8687, Factor 3 accounted for 2.1069, Factor 4 accounted for 1.6248, Factor 5 accounted for 1.2142, and Factor 6 accounted for 1.0799.

Conclusions

The study showed that the instrument indicated a strong reliability. The original instrument had alpha coefficient=.82. Then after removing three items the alpha coefficient increased to 0.86. The part to whole

correlation for the final 21 items showed that each item correlated significantly to the whole measurement. No serious problem was found in terms of inter-correlation among the items. The validity instrument was achieved through content validity and criterion validity.

R-Factor analysis showed that there were six underlying dimensions that comprise the Students Attitudes Toward Statistics (STATS). They were: Students interest and applicability; relationship and impact of the instructor; attitude toward statistical tools; self confidence; parental influence; and initiative and extra effort in learning statistics.

The instrument might be useful for statistics instructors to know their STATS. So, they could provide better teaching strategies to overcome the problems in teaching statistics course. It also would be useful for educational researchers to measure the STATS. However, the instrument still needs improvement. There is no research without error. Then, the finding here might just apply to the sample statistics classes in the College of Commerce & Business Administration, and the College of Education, the University of Alabama.

REFERENCES

Benson, Jeri. (1989). Structural components of statistical test anxiety in adults: An exploratory model. Journal of Experimental Education, 57, (3), 247-261

Collis, B., Oberg, A., & Shera, W. (1989). An evaluation of computer-based instruction in statistical techniques for education and social work students. Journal of Educational Technology System, 17, (1), 59-71.

Elmore, P. B., & Vasu, E. S. (1986). A model of statistics achievement using spatial ability, feminist attitude and mathematics-related variables as predictors. Educational & Psychological Measurement, 46, (1), 215-221.

Frank, M. L., & Rickard, K. (1988). Psychology of the scientist: LVIII: Anxiety about research: An initial examination of a multidimensional concept. Psychological Reports, 62, 455-463.

Katz, B. M., & Tomazic, T. Z. (1988). Changing students' attitudes toward statistics through a nonquantitative approach. Psychological Reports, (62), 658.

Kim, J. O., & Mueller, C. W. (1991). Factor Analysis. Sage University Papers on Quantitative Application in the Social Sciences. Newsbury Park and London: Sage Pub.

Raiszadeh, F. M. D., & Ahmadi, M. (1987). Students' race and gender in introductory business statistics. Journal of Education for Business Statistics, 63, (1), 21-23.

Roberts, D. M., & Bilderback, E. W. (1980). Reliability and validity of a statistics attitude survey. Educational and Psychological Measurement, 40, (1), 235-238.

Roberts, D. M., & Reese, C. M. (1987). A comparison of two scales measuring attitudes toward statistics. Educational and Psychological Measurement, 47, (3), 759-764.

Roberts, D. M., & Saxe, J. E. (1982). Validity of a statistics attitudes survey: A follow-up study. Educational and Psychological Measurement, 42, (3), 907-912.

Ware, M. E., & Chastain, J. D. (1989). Computer-assisted statistical analysis: A teaching innovation? Teaching of Psychology, 16, (4), 222-227.

Waters, L. K., Martelli, T., Zakrajsek, T., Popovich, P. M. (1988). Attitudes toward statistics: An evaluation of multiple measure. Educational and Psychological Measurement, 48, 513-516

Wise, Steven L. (1985). The development and validation of a scale measuring attitudes toward statistics. Educational and Psychological Measurement, 45, (2), 401-405.

Zeidner, M., & Safir, M. P. (1989). Sex, ethnic, and social differences in test anxiety among Israeli adolescents. Journal of Genetic Psychology, 150, (2), 175-185.

STUDENTS' ATTITUDE TOWARD STATISTICS (STATS)

Dear Students: I would appreciate your help in completing these statements about your attitude toward statistics. Your responses will be kept confidential.

DIRECTIONS : Your responses to all survey items are to be coded on the green response (answer) sheet provided. You must use a No. 2 lead pencil when marking your response. The first section is for demographic purposes only and the second one is the major questions of the research. In the NAME grid (upper left) of the answer sheet, please print your name in the spaces provided starting with your last name, then your first name, and then middle initial. Then, fill in the circles in each column corresponding to the letters in your name. In the SEX grid, fill in the circle containing M if you are Male and F if you are Female. In the BIRTH DATE grid, fill in the circle the month, the day, and the year of your birth date. In the IDENTIFICATION NUMBER section of the answer sheet, fill in the circle under column associate to the question (A to G) containing the number that best identifies you.

A. What is your current class level.

0. Freshman	3. Senior	6. Ed.D Degree
1. Sophomore	4. Master's Degree	7. Ph.D Degree
2. Junior	5. Specialist Degree	8. Others

B. How long have you studied in higher education up until this year.

0. 0 - 1 year	5. 6 years
1. 2 years	6. 7 years
2. 3 years	7. 8 years
3. 4 years	8. 9 years
4. 5 years	9. 10 years or more

C. What college/school are you in as a student.

0. Art & Sciences	5. Human Environmental Sciences
1. Commerce & Business Adm.	6. Library Service
2. Communication	7. Nursing
3. Education	8. Social Work
4. Engineering	9. Others

D. How many previous college mathematics level have you had.

0. 0	2. 2	4. 4	6. 6	8. 8
1. 1	3. 3	5. 5	7. 7	9. 9

E. How many previous statistics class do you have.

0. 0	2. 2	4. 4	6. 6	8. 8
1. 1	3. 3	5. 5	7. 7	9. 9

F. What is your race/ethnic background.

0. American Indian or Alaskan Native	3. Hispanic
1. Asian or Pacific Islander	4. White
2. Afro American	5. Others

G. What is your grade on your last midterm examination (based on 100%)

0. 00-55	2. 61-65	4. 71-75	6. 81-85	8. 91- 95
1. 56-50	3. 66-70	5. 76-80	7. 86-90	9. 96-100

DIRECTION : Rate each of the following by filling in the appropriate circle with number from "0" (NOT DESCRIBE ME) to "9" (DESCRIBE ME). Bubble in the number which best describes your response for each of the following statements.

NOT DESCRIBE ME 0 1 2 4 5 6 7 8 9 DESCRIBE ME

1. Learning statistics is easy for me.
2. I understand statistics better than the majority of people in my class.
3. Statistics makes me anxious.
4. I like working with numbers.
5. I enjoy working with calculator.
6. I enjoy working with computer.
7. My mother likes mathematics or statistics, so I will.
8. My father likes mathematics or statistics, so I will.
9. I feel that statistics is only for men.
10. Statistics is very useful in my major.
11. Statistics will improve my research ability.
12. Statistics will be important for my future career.
13. I will be more competent in my subject area when I master statistics.
14. I can master statistics with great deal of effort.
15. I study statistics regularly even when there is no specific assignment.
16. I see my instructors when I do not understand something in my statistics class.
17. I ask questions in my statistics class when I do not understand.
18. I find statistics is very interesting subject.
19. If a statistics course were not required for my major I would not take one.
20. I like statistics because of my instructor's method of teaching.
21. The instructor's friendliness in answering students questions helps me to like statistics.
22. The instructor's explanations help me to like statistics.
23. I did not like statistics before I took this class.
24. I like statistics now.